CHAPTER 1. INTRODUCTION

Section 1. GENERAL

1.1.1 PURPOSE. This technical manual has been prepared by the military services to provide complete uniform information and establish standard practices for the painting of buildings, structures, and fixed equipment. Advances in paint technology have led to the development of many coatings formulated to meet specific requirements and conditions. Generally, more than one painting system is well suited for the combination of surface, environment and service required. Similarly, surface preparation, the choice of equipment, and the method of application may vary according to the severity of the exposure, the coating used, and the conditions under which it is applied. Each of these factors contributes to the effectiveness of the completed job. The purpose of this manual is to describe proper methods for surface preparation, to delineate satisfactory paint systems, and to recommend proper procedures for application of these paint systems to effectively protect and economically maintain a variety of surfaces.

1.1.2 SCOPE. The contents of this manual relate to the operations necessary to paint interior and exterior surfaces of all buildings, structures, and related facilities, including utility systems, traffic markings and signs. Exposure conditions covered include all environments. In addition, certain sections of the manual cover the application of special coatings such as odorless, vapor-proof, and nonslip finishes, as well as the painting of special areas and surfaces such as hot surfaces, clean rooms, glass, plastics, and insulation. The manual is not concerned with the painting of mobile equipment such as aircraft, ships, vehicles, and missiles, nor equipment not listed on the real property records.

1.1.3 TERMINOLOGY. The following terms will be used frequently throughout the manual.

1.1.3.1 Paint or Coating. All materials used in painting, such as paints, enamels, varnishes, lacquers, sealers, and stains. The film-forming portion of these may include oil, alkyd, latex, vinyl, epoxy, urethane, phenolic, acrylic, and others.

1.1.3.2 Painting. All operations required to use paints properly including the determination of the condition of the surface, the preparation required for painting, the choice of products to be used, conditioning of paint before use, choice of equipment, application, and inspection.

1.1.3.3 Surface Preparation. All operations necessary to prepare a surface to receive a coating of paint. Surface preparation consists of one or more of the following procedures:

a. Cleaning: The removal from the surface of contaminants such as dirt, oil, grease, rust, mill scale, and loose paint by cleansing, mechanical abrasion, or by chemical etching. Liquid paint removers are sometimes used but are limited to small areas. Cleansing methods include washing with a detergent or soap solution, steam cleaning, or solvent cleaning. Mechanical abrasion methods include wire brushing, sanding, abrasive blasting, or the use of chipping hammers and tools. Pickling is the most common type of chemical etching.

b. Repair of Surfaces: The filling of all cracks and crevices in the substrate, setting and covering all exposed nail heads, and any other general repairs necessary to return the substrate or fixture to a satisfactory condition for painting. Procedures include calking, puttying, glazing, and patching.

c. Pretreatment: The chemical alteration of the surface necessary to make it suitable for painting. Typical methods include the use of conversion treatments based on zinc or iron phosphate conforming to Federal specification and tie coats (wash primers).

d. Seal Coating or Conditioning: The sealing of very porous substrates such as plywood, or the treatment of degraded surfaces such as weathered concrete and masonry or chalky old paint to prevent excessive absorption of the first coat of paint. The sealer or conditioner is a thin liquid which penetrates the porous surface or ties in loose material.

e. Wetting Oil: Used when all mill scale and rust cannot be readily removed. This oil penetrates rust and scale, thereby improving bonding of the subsequent coatings applied.

1.1.3.4 Useful Life. The length of time a paint coating is expected to remain serviceable before repainting is required.

1.1.3.5 Paint Failure. The loss of usefulness of the paint coating. Premature failure may come from improper or inadequate surface preparation, faulty choice of paint, use of substandard materials, faulty application, or unusually severe conditions of exposure.

1.1.4 GLOSSARY. A detailed listing of terms associated with painting, which will be useful in understanding the manual, is given in Appendix A. Terms are listed alphabetically and explanations, though brief, are sufficient to acquaint the engineer, painter, and inspector with their meaning.

Section 2. PURPOSE OF PAINTING

1.2.1 PROTECTION. Protection of the surface is the most important consideration in determining the maintenance cost of structures. Typical causes of failure are sunlight, temperature variations, fresh and salt water, water vapor, rot, mildew, chemicals, and abrasion. Paint serves as a protective shield between the base construction materials and the elements which attack and deteriorate them. Painting, when regularly programmed, offers long range protection that extends the useful life of the structure.

1.2.2 SANITATION AND CLEANLINESS. Paint and proper painting operations promote sanitation and cleanliness. Paint coating provide smooth, nonabsorptive surfaces which are easily washed and kept free of dirt. Such surfaces tend to prevent foodstuffs from adhering. Adhering foodstuffs harbor germs and cause disease. The coating of rough or porous areas seals out dust and grease that would otherwise be difficult to remove. Paint coatings, merely by contrast, will reveal build-up of foreign substances thereby indicating that better housekeeping practices are in order. Therefore, painting is an essential part of general maintenance programs for hospitals, kitchens, mess halls, offices, warehouses, and living quarters.

1.2.3 ILLUMINATION AND VISIBILITY. White and light tinted paints applied to ceiling and walls reflect both natural and artificial light and help brighten rooms and increase visibility. On the other hand, darker colors reduce the amount of reflected light. Flat paints diffuse, soften, and evenly distribute illumination, whereas gloss finishes reflect more like mirrors and may create glare. Color contrasts improve visibility of the painted surface especially when the paint is applied in distinctive patterns. For example, white on black, white on orange, or yellow on black can be seen at greater distances than single colors or other combinations of colors.

1.2.4 SAFETY AND EFFICIENCY. Certain colors are universally associated with potentially dangerous situations or personal safety. Red, yellow, and green are obvious examples. Materials handling equipment is generally painted yellow and fire protection equipment is always painted bright red. Colors are also used to improve both safety and efficiency by color coding hazardous areas, emergency apparatus, power lines, piping, valves, switches, and operational equipment. Marking paints are used to control flow of traffic and to indicate safe pas- sages and parking areas.

1.2.5 APPEARANCE. Painting is primarily used for maintenance and to improve safety and efficiency. Decorative painting is of secondary importance and should be kept at a minimum. However, the functional use of color does create comfortable living and working conditions and more pleasant surroundings that result in improved morale and increased efficiency. Guidance on color selection for buildings and facilities is given in Army TM 5-807, Color for Buildings, and in NAVFAC P-309, Color for Naval Shore Facilities.

1.2.6 CAMOUFLAGE. Camouflage paints have special properties which are different from conventional paints and their use is limited to special applications. Do not use camouflage paints as substitutes for conventional paints unless special instructions have been received to do so.

1.2.7 TONE DOWN (PASSIVE DEFENSE). Tone-down represents the use of conventional coatings and special stains for blending existing exposed facilities with the surrounding environment. This is done in order to render selected military installations less conspicuous.

1.2.8 FIRE RETARDANCE. Certain paints delay the spread of fire and assist in confining it to its origin. This allows more time during which fire fighting equipment can arrive to extinguish the blaze before it gets out of control. The use of fire-retardant paints is restricted to appreciable areas of highly combustible surfaces and for selected uses. Their use is further restricted to interior surfaces except for Arctic areas. Fire-retardant paints must not be considered as substitutes for conventional paints, and their use must be justified and must be governed by specific agency criteria.

Section 3. SPECIFICATIONS, SAMPLING, TESTING, INSPECTION

1.3.1 USE OF PRODUCT SPECIFICATIONS. Product specifications have been developed for paints and allied products to clearly establish quality standards. They provide a fair basis on which manufacturers can bid competitively and a

sound basis for acceptance or rejection of material by the buyer. A list of applicable specifications is given in Appendix D. Note: These specifications are referred to by basic symbol only, with no reference to the final suffix letter, e.g., TT-E-489 not TT-E-489d, because of the frequency with which specifications are modified. In writing contract specifications designate the latest product specifications including amendments, also the type or class if applicable.

1.3.2 SAMPLING AND TESTING. Sample and test all paints and allied products before use. Unless such testing is done and the sample found to comply with the specification, the user cannot be certain of the quality of the material. When samples are taken from contractor material, a representative of the contractor should be present during sampling and certify that sampling was properly done.

1.3.3 JOB INSPECTION. All painting requires continuous inspection for best results. Inspectors, who are especially trained, will check all jobs daily. Examine all surfaces to be painted to determine that preparation is adequate. Check all materials to see that they are those specified or selected for the job and have not been tampered with. Inspect the job during application to determine that proper procedures are used, that film thickness is as specified, and that the applied paint is of the correct color and appearance and is uniform, without sags or runs. Frequent, diligent inspection of all materials and procedures during each stage of surface preparation and paint application is the most effective means of ensuring quality control.

1.3.4 JOB ACCEPTANCE INSPECTION. Post-job inspection must be preceded by complete step-by-step on-the-job inspection to ensure that proper procedures were followed. Inspection of a completed job is less effective without certain knowledge that the product was correctly applied to a properly prepared surface in accordance with specification requirements. The main purpose of post-job inspection is to be sure that the applied paint system meets the established minimum requirements for film thickness, leveling, gloss (or flatness), hiding and color, prior to final approval.

Section 4. REQUIREMENTS FOR PAINTING OPERATIONS

1.4.1 SUPERVISION. Use only experienced personnel as supervisors. This is important in the operation of specialized equipment and in the use of highly toxic materials. Foremen must have a thorough knowledge of painting procedures, maintenance problems, operation and maintenance of equipment, and safety precautions. All jobs must be checked frequently to be sure that personnel are preparing surfaces properly, that they are using paints properly with regard to mixing and conditioning, that application is uniform and at proper film thickness, and that the proper drying time is allowed between coats. Supervisors will set up program schedules for painting on a systematic basis; they are responsible for recording work progress, gallonage used, and for daily project and job acceptance inspection reports.

1.4.2 SURFACE CONDITION. The condition of the surface to be painted is of utmost importance, particularly in maintenance painting where protective requirements are most stringent and premature film failure is costly. Adhesion of coatings is best when the surface is clean, dry, and slightly rough.

Therefore, surfaces must be free of dirt, oil and grease, rust and mill scale, loose paint, excessive chalk, mildew, and any other substances which affect adhesion immediately or after prolonged exposure. Knots and pitch streaks in new or bare wood must be primed with a special sealer. Glossy surfaces must be sanded or roughened. Old paint, which is not glossy but otherwise in good condition, can be painted with nominal cleaning provided that similar or compatible coatings are applied over it. There is no substitute for proper and complete surface preparation. Service life of a paint can be greatly extended by good surface preparation before painting.

1.4.3 WEATHER. Surface, ambient, and material temperatures, moisture conditions and wind velocity affect the application, drying time and adhesion of paints as well as the efficiency of the painter. Low temperatures thicken paints, making them difficult to apply, prevent smooth leveling, and retard drying. High temperatures cause the opposite to take place, i.e., viscosity is low so that paints spread too far, resulting in inadequate film thicknesses. Also, paints tend to sag and set up too rapidly. This results in lap marks and may even result in wrinkling and loss of adhesion under extreme circumstances. Humidity, dampness, and frost retard drying time and are common causes of blistering and poor adhesion. High wind velocity makes application extremely difficult.

1.4.4 ENVIRONMENTAL CONDITIONS. All structural materials will deteriorate if not protected, hence the need for an adequate paint system which will resist the particular environment.

1.4.4.1 Interior Environments. Interior painting is intended primarily for cleanliness, illumination, and general appearance. The areas where the environment can be detrimental are limited to specific areas such as shower rooms and laundries where water, water vapor, and steam are present, to kitchens where heat and cooking fumes are also present, and to floors where abrasion is a problem.

1.4.4.2 Normal Exterior Environments. Exterior paints must protect the structure against exposure to sunlight, rain, snowfall, wind, and temperature changes. Therefore, careful surface preparation and paint application are more important than for interior finishes, and paints formulated especially for exterior exposure must be used.

1.4.4.3 Abnormal Exterior Environments. The most difficult environments to which structures are exposed are those in which conditions are abnormal or where corrosive materials are present. Examples and typical areas are as follows:

a. Extreme temperatures--as found in the tropics and Arctic regions

b. Rapid temperature changes--as observed in the central United States

c. Intense ultraviolet radiation--as present in the southwest United States

d. Excessive moisture (continual high humidity and/or heavy rainfall)--as present in the southern United States and the tropics

e. Salt water and vapor--as present in coastal areas

f. Corrosive fumes (sulfide and other chemical fumes)--as present in industrial areas.

Protection against these environments requires the choice of paints especially designed for resistance to these exposures, plus particularly careful surface preparation and paint application. Deterioration, if allowed to take place, will proceed much more rapidly than under normal conditions. There must be no compromise whatsoever in the paints used, painting operations, and inspection, in order to achieve the desired service in abnormal environments.

Section 5. RESTRICTIONS ON USE OF LEAD-CONTAINING PAINTS

1.5.1 BACKGROUND. Public Laws and Regulations:

a. Limit the lead in paints. Any paint manufactured on or after 23 June 1977 "may contain no more than six one-hundredths of one percentum lead by weight (calculated as lead metal) in the total nonvolatile content of liquid paint or in the dried film of the paint already applied."

b. Prohibit the use of lead-based paints in residential structures constructed or rehabilitated by the Federal Government or with Federal assistance.

Residential structures are defined as any house, apartment or structure intended for human habitation, including any institutional structure where persons reside, such as an orphanage, boarding school, dormitory, day care center, extended care facility, college housing, hospital, group practice facility, or community facility.

c. Ban toys and other articles intended for use by children, bearing lead-containing paints, and furniture articles for consumer use bearing lead-containing paint.

d. Ban paint and similar surface coating materials for consumer use that contain excessive amounts of lead.

Applicable surfaces are defined to include all interior surfaces, whether accessible or not, and those exterior surfaces such as stairs, decks, porches, railings, windows and doors which are readily accessible to children under the age of seven.

Certain exemptions have been made for special purpose coatings. The following products are specifically exempted from the ban, provided that the requisite labeling is used:

a. Agricultural and industrial equipment refinish coatings

b. Industrial and commercial building and equipment maintenance coatings, including traffic and safety marking coatings

c. Graphic art coatings, i.e., products marketed solely for application on billboards, road signs, and for identification marking in industrial buildings

d. Touch-up coatings for agricultural equipment, lawn and garden equipment, and appliances

e. Catalyzed coatings marketed solely for use on radio-controlled model powered aircraft

Appliances and certain other named items are specifically mentioned as not being included in the new regulation.

1.5.2 REQUIREMENTS. In view of the foregoing, the interior of residential structures and exterior surfaces accessible to children (window sills, porches, railings, etc.) will not be coated with lead-containing paint. Residential structures are defined as housing, barracks, quarters, and similar domiciliary structures in addition to other structures that may be converted to such use.

Current regulations, directives, or instructions issued by each of the services shall be reviewed and complied with. Such regulations restrict in-house use of lead-based paint and require inclusion of appropriate provisions in contracts and sub-contracts.

Federal specification paints that contain lead and should not be used in the above described conditions include the following: TT-E-485, TT-P-59, TT-P-61, TT-P-71, TT-P-81, TT-P-86, and TT-P-615. Military specification paint MIL-P-15929 is also included.

Other Federal specification paints in which certain colors, notably yellow, orange, and green, either require lead pigments or may be used at the option of the supplier include the following: TT-E-489, TT-E-490, TT-E-529, and TT-P-37.

Nonresidential type structures are not affected by the recommendations nor is the use of lead-containing coatings on surfaces of components in concealed spaces, such as steel beams in ceilings, and in walls of residential structures.

Section 6. RESTRICTIONS ON USE OF MERCURY CONTAINING FUNGICIDES IN PAINTS

1.6.1 REQUIREMENTS. The Environmental Protection Agency (EPA) established regulations in which mercury-containing fungicides are not to be used in solvent-thinned (oil-based) paints. Their use in paints is limited to use as a preservative for interior water-thinned paint and as a fungicide for exterior water-thinned paints. EPA has not set limits on the amount of mercury to be used and simply states that establishing of limits is consistent with good practice. However, the Federal Hazardous Substances Act limits the use to 0.2 percent mercury (calculated as metal) in the total weight of the paint.

Section 7. RESTRICTIONS ON USE OF SOLVENTS

1.7.1 BACKGROUND. Studies on the factors leading to lung and eye-irritating smog in the Los Angeles area led to Los Angeles Air Pollution Control District Rule 66 which restricted the use of organic solvents in paints. Smog chamber work with solvents and oxidants resulted in the classification of solvents which after irradiation did not significantly promote oxidant formation (smog) and a group that did. Rule 66 classified the "nonreactive" solvents as exempt, and those that did react as nonexempt. Rule 66 was based only on the production of eye irritants in the smog chamber after 6 hours of irradiation. Thus, unlimited use of exempt solvents was allowed, but the use of nonexempt solvents was restricted. Federal and military coatings specification requirements were changed to comply with Rule 66 (later changed to Rule 442). The passage of the Clean Air Act of 1970 involved the Environmental Protection Agency (EPA) with solvents to be used in coatings. In California, the California Air Resources Board (CARB) developed a proposed model solvent restrictive regulation, because it was found that all volatile organic compounds contribute significantly to the formation of oxidants. A modified version of the model rule was adopted by the South Coast Air Quality Management District (SCAQMD). This regulation, Rule 1113, went into effect September 2, 1979, and similar regulations have been or will be adopted by other air pollution control districts in California. The California Architectural Coatings Regulations drastically reduce the allowable solvent content of most consumer products. At present, military bases in the affected air pollution control districts in California are expected to comply with the regulations.

1.7.2 REQUIREMENTS. The regulations state that no person may sell, offer for sale, or apply any architectural coatings manufactured after the effective date which contain more than 250 grams of volatile organic material (VOM) per liter of coating as applied, excluding water. The rule applies to any coating used on stationary structures and their appurtenances, mobile homes, pavements or curbs.

The 250-gram per liter restriction does not apply to the following coatings manufactured prior to September 2, 1982: architectural coatings supplies in containers having capacities of 1 liter or less; traffic coatings applied to public streets and highways; varnishes, lacquers or shellacs; semitransparent stains; opaque stains on bare redwood, cedar mahogany, or douglas fir; primers, sealers or undercoaters; wood preservatives; fire-retardant coatings; tile-like glaze coatings; waterproofing coatings -- except bituminous pavement sealers; industrial maintenance finishes; metallic pigmented coatings; swimming pool coatings; graphic art coatings; mastic coatings; and multicolored coatings.

A carryover provision from rules presently in effect in the districts requires that any architectural coating presently exempt from the 250-gram per liter limitation and sold in containers of 1 quart capacity or larger must be formulated with nonphotochemically reactive solvent.

Containers for all coatings subject to the 250-gram per liter limitation must display the manufacture date of the content or a code indicating the date.